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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/621,712	07/17/2003	Qi Wang	NREL 02-34	1540

23712 7590 04/16/2007  
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EXAMINER
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GHYKA, ALEXANDER G

ART UNIT	PAPER NUMBER
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2812

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/16/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

# Office Action Summary

Application No.

10/621,712

Applicant(s)

WANG, QI

Examiner

Alexander G. Ghyska

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-11, 20-22 and 24-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-11, 20-22 and 24-26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

ALEXANDER GHYKA  
PRIMARY EXAMINER

Av 2812  
*Alex Ghyska*

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 17 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_.

### DETAILED ACTION

Applicants' response of 1/19/2007 has been entered. The Examiner has reconsidered the Osono et al reference, (Coverage Properties of Silicon Nitride film prepared by the Cat-CVD method, Thin Solid Films, April 2003). The Examiner's indication of allowability of Claims 23 and 27 was based on Applicants' arguments that the afore mentioned article provided much lower step coverage in a similar process, and therefore the limitation "100 % step coverage" was unobvious. However, upon careful review the Examiner notes that the lower step coverage percentages pertain to a catalyst based CVD process, which is different than the claimed thermal CVD process. See page 5, first paragraph of section 3.2. The Examiner also notes values of about 90% coverage for thermal CVD processes are disclosed. See page 5, first paragraph of section 3.2. The following *new* rejection is made in light of this more careful reading of the Osona et al reference. Accordingly, this rejection is a *NON-Final rejection*. Claims 1-11, 20-22 and 24-26 are now under consideration.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

**Claims 1-11, 20-22 and 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsumura et al (US 2002/0189545) in view of Bu et al (US 6,806,149 and Osono et al (Coverage Properties of Silicon Nitride film prepared by the Cat-CVD method, Thin Solid Films, April 2003 "Osono et al").**

The present Claims generally require heating a substrate to be subjected to film formation, heating a wire to a wire temperature, supplying silane, ammonia and hydrogen, and forming a conformal silicon nitride film on the substrate, wherein excess hydrogen or process gas is supplied in an amount sufficient to form a substantially 100 % conformal silicon nitride film on the substrate, wherein the conformal silicon nitride film has a highly uniform thickness providing 100 % step coverage.

Matsumura disclose heating a substrate to be subjected to film formation, heating a wire to a wire temperature, supplying silane, ammonia and hydrogen, and forming a silicon nitride film as required by present Claims 1, 5, 6, 7 and 8. See page 2, paragraphs 19- 20; page 9, paragraph 112 and page 10, paragraphs 124-126.

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Matsumura further discloses a substrate temperature of 200 degrees Celcius and a wire temperature of 2000 degrees Celcius as required by present Claims 2, 3, and 9-10. See page 2, paragraph 20. Matsumura discloses providing an excess of hydrogen gas, although for the benefit of preventing the deterioration of the heating element. See paragraph 129, page 10.

Matsumura et al differs from the presently claimed invention in that it does not disclose the formation of a conformal nitride layer, wherein excess hydrogen or process gas is supplied in an amount sufficient to form a substantially 100 % conformal silicon nitride film on the substrate, wherein the conformal silicon nitride film has a highly uniform thickness providing 100 % step coverage.

Bu et al disclose a CVD process which uses silane, ammonia and hydrogen to form conformal silicon nitride layers. See Figures 2A – 2D, column 3, lines 5-10 and column 3, line 65 to column 4, line 30.

Osono et al disclose a catalyst CVD process which uses silane and ammonia to form a silicon nitride film. Osono et al disclose that thermal CVD processes result in step coverage of over 90 %. See Section 3.2, first full paragraph of Osono et al.

It would have been obvious for one of ordinary skill at the time of the invention, to use the process of Matsumura et al to form a conformal silicon nitride layer as disclosed by Bu et al, as both processes pertain to CVD processes which form silicon nitride and

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use hydrogen, ammonia and silane as reactants. As Bu et al disclose that CVD processes using the afore mentioned reactants are known in the art, the use of a known process, CVD using hydrogen, silane and ammonia as reactants, to form a known product, a conformal CVD layer, is *prima facie* obvious. Moreover, the excess hydrogen of Matsumura combined with the disclosure of Bu et al that it is known to form conformal nitride layers, would make it *prima facie* obvious for one of ordinary skill in the art to arrive at the present limitations, as the recitation of an additional advantage associated with doing what the prior art suggests does not lend patentability to an otherwise unpatentable invention. See *In re Lintner* 173 USPQ 560 (CCPA 1972) and *In re Dillon*, 16 USPQ 2d 1897 (Fed. Cir. 1990). Moreover, with respect to the limitation “about 100 % step coverage”, this limitation would have been obvious, as Osono et al disclose that thermal CVD processes with silane and ammonia reactants disclose step coverages of over 90%. It would have been obvious for one of ordinary skill in the art, at the time of the invention, to arrive at the presently claimed step coverage as the discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art. See *In re Aller*, 105 USPQ 233 (1955) and *In re Antonie*, 195 USPQ 6 (CCPA 1977). In this case the step coverage would be considered a result effective variable by one of ordinary skill in the art, and the selection of the optimum parameters would be within the level of skill of one of ordinary skill in the art as simply a matter of optimization. As Osono et al disclose step coverage of over 90% for thermal CVD reactions, it is within the skill of one of ordinary skill in the art to arrive at the limitation of “about 100 %”.

Claims 4 and 11 further require pressures of 10-50 millitorr.

Matsumura et al is relied upon as discussed above, and disclose pressures of about 0.1 PA to 100 Pa.

It would have been obvious for one of ordinary skill in the art, at the time of the invention, to arrive at the presently claimed pressures as the discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art. See *In re Aller*, 105 USPQ 233 (1955) and *In re Antonie*, 195 USPQ 6 (CCPA 1977). In this case the pressure would be considered a result effective variable by one of ordinary skill in the art, and the selection of the optimum parameters would be within the level of skill of one of ordinary skill in the art as simply a matter of optimization.

Claims 20-22 and 24-26 further require the conformal layer to have uniform thickness and exhibit a highly uniform thickness.

The figures of Bu et al show uniform thickness and highly uniform thickness. See Figures 2A-2D of Bu et al.

It would have been obvious to one of ordinary skill in the art, at the time of the invention, to arrive at the presently claimed thickness and uniform thickness as the discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art. See *In re Aller*, 105 USPQ 233 (1955) and *In re Antonie*, 195 USPQ 6 (CCPA 1977). In this case the uniformity of the thickness and the percentage of conformity would be considered result effective variables by one of



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ordinary skill in the art, and the selection of the optimum parameters would be within the level of skill of one of ordinary skill in the art as simply a matter of optimization.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexander G. Ghyka whose telephone number is (571) 272-1669. The examiner can normally be reached on Monday through Friday during general business hours.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

AGG

April 9, 2007

ALEXANDER GHYKA  
PRIMARY EXAMINER

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*[Handwritten signature]*